



Tennessee Valley Authority, Post Office Box 2000, Soddy Daisy, Tennessee 37384-2000

October 15, 2012

10 CFR 50.73

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Sequoyah Nuclear Plant, Unit 2
Facility Operating License No. DPR-79
NRC Docket No. 50-328

Subject: Licensee Event Report 328/2012-001, "Automatic Reactor Trip on Loss of Flow due to a Reactor Coolant Pump Trip"

The enclosed Licensee Event Report (LER) provides details concerning an automatic reactor trip and automatic engineered safety feature actuation of the auxiliary feedwater system following a reactor coolant pump trip. The Tennessee Valley Authority is submitting this report in accordance with 10 CFR 50.73(a)(2)(iv)(A), as an event that resulted in a valid actuation of the reactor protection system and the auxiliary feedwater system.

There are no regulatory commitments contained in this letter. Should you have any questions concerning this submittal, please contact Mr. James Proffitt, Sequoyah Site Licensing Manager at (423) 843-6651.

Respectfully,



John T. Carlin
Site Vice President
Sequoyah Nuclear Plant

Enclosure: Licensee Event Report -
cc: Regional Administrator – Region II
NRC Senior Resident Inspector – Sequoyah Nuclear Plant

IE22
NRR

LICENSEE EVENT REPORT (LER)(See reverse for required number of
digits/characters for each block)

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA/Privacy Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects.resources@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

1. FACILITY NAME

Sequoyah Nuclear Plant Unit 2

2. DOCKET NUMBER

05000328

3. PAGE

1 OF 7

4. TITLE:

Automatic Reactor Trip on Loss of Flow due to a Reactor Coolant Pump Trip

5. EVENT DATE

MONTH DAY YEAR

08 16 2012

6. LER NUMBERYEAR SEQUENTIAL
NUMBER REV
NO.

2012 - 001 - 00

7. REPORT DATE

MONTH DAY YEAR

10 15 2012

8. OTHER FACILITIES INVOLVED

FACILITY NAME

DOCKET NUMBER

FACILITY NAME

DOCKET NUMBER

9. OPERATING MODE

1

10. POWER LEVEL

100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

- | | | | |
|---|---|--|--|
| <input type="checkbox"/> 20.2201(b) | <input type="checkbox"/> 20.2203(a)(3)(i) | <input type="checkbox"/> 50.73(a)(2)(i)(C) | <input type="checkbox"/> 50.73(a)(2)(vii) |
| <input type="checkbox"/> 20.2201(d) | <input type="checkbox"/> 20.2203(a)(3)(ii) | <input type="checkbox"/> 50.73(a)(2)(ii)(A) | <input type="checkbox"/> 50.73(a)(2)(viii)(A) |
| <input type="checkbox"/> 20.2203(a)(1) | <input type="checkbox"/> 20.2203(a)(4) | <input type="checkbox"/> 50.73(a)(2)(ii)(B) | <input type="checkbox"/> 50.73(a)(2)(viii)(B) |
| <input type="checkbox"/> 20.2203(a)(2)(i) | <input type="checkbox"/> 50.36(c)(1)(i)(A) | <input type="checkbox"/> 50.73(a)(2)(iii) | <input type="checkbox"/> 50.73(a)(2)(ix)(A) |
| <input type="checkbox"/> 20.2203(a)(2)(ii) | <input type="checkbox"/> 50.36(c)(1)(ii)(A) | <input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A) | <input type="checkbox"/> 50.73(a)(2)(x) |
| <input type="checkbox"/> 20.2203(a)(2)(iii) | <input type="checkbox"/> 50.36(c)(2) | <input type="checkbox"/> 50.73(a)(2)(v)(A) | <input type="checkbox"/> 73.71(a)(4) |
| <input type="checkbox"/> 20.2203(a)(2)(iv) | <input type="checkbox"/> 50.46(a)(3)(ii) | <input type="checkbox"/> 50.73(a)(2)(v)(B) | <input type="checkbox"/> 73.71(a)(5) |
| <input type="checkbox"/> 20.2203(a)(2)(v) | <input type="checkbox"/> 50.73(a)(2)(i)(A) | <input type="checkbox"/> 50.73(a)(2)(v)(C) | <input type="checkbox"/> OTHER |
| <input type="checkbox"/> 20.2203(a)(2)(vi) | <input type="checkbox"/> 50.73(a)(2)(i)(B) | <input type="checkbox"/> 50.73(a)(2)(v)(D) | Specify in Abstract below
or in NRC Form 366A |

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME

Jon Johnson, Program Manager

TELEPHONE NUMBER (Include Area Code)

(423) 843-8129

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU- FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU- FACTURER	REPORTABLE TO EPIX
E	EC	RLY	B455	Y					

14. SUPPLEMENTAL REPORT EXPECTED☐ YES (If yes, complete 15. EXPECTED SUBMISSION DATE) ☒ NO**15. EXPECTED
SUBMISSION
DATE**

MONTH DAY YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On August 16, 2012, at approximately 1926 Daylight Savings Time, Sequoyah Nuclear Plant (SQN) Unit 2 automatically tripped on a single loop loss of flow following reactor coolant pump (RCP) 2-4 trip. RCP 2-4 tripped as a result of the 250 volts direct current RCP control circuit energizing the trip coil for RCP 2-4 without a valid signal, resulting in a Unit 2 trip. No testing or surveillance was in progress at the time of the event.

Unit 2 was stabilized in hot standby following the automatic reactor trip. The cause of the trip was determined to be the inadvertent operation of a GR-5 ground fault relay, designated as device 50G. Failure of the GR-5 relay was caused by the failure of the metal oxide varistor, which is an internal component to the solid state GR-5 relay. The root cause for the failure of the metal oxide varistor was determined to be inadequate preventative maintenance instructions and implementation frequency on GR-5 relays in critical systems. The corrective actions include revising preventative maintenance procedures to address replacement of ABB/ITE relays for critical components. An additional action will replace Unit 1 and Unit 2 ABB/ITE relays, for critical components, that have been in service greater than five refueling cycles based on Operations review of critical components that are directly related to causing a plant trip or Limiting Condition for Operation entry for 8 hours or less. There were no actual safety consequences impacting plant or public safety as a result of this event.

**LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET**

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
Sequoyah Nuclear Plant Unit 2	05000328	YEAR	SEQUENTIAL NUMBER	REV NO.	2 OF 7
		2012 --	001 --	00	

NARRATIVE

I. PLANT CONDITION(S)

At the time of the event, SQN Unit 2 was operating at approximately 100 percent rated thermal power (RTP).

II. DESCRIPTION OF EVENT

A. Event:

On August 16, 2012, at approximately 1926 Daylight Savings Time (DST), Main Control Room (MCR) annunciator [EIS-IB] alarmed, indicating low flow in reactor coolant system (RCS) [EIS AB] loop 4. Reactor coolant pump 2-4 (RCP) [EIS Code AB, P] tripped because a relay failure energized the trip coil of RCP 2-4 breaker. As a result of the low flow condition, the Unit 2 reactor [EIS-JC] automatically tripped from approximately 100 percent power and was followed by an automatic turbine trip. MCR operators promptly initiated emergency operating procedures and responded to the event in accordance with plant procedures. They promptly diagnosed the plant conditions, took the actions necessary to stabilize the unit, and maintained the unit in hot standby, MODE 3.

A bridge and megger test on RCP 2-4 motor was successfully performed on August 17, 2012, validating the trip was not associated with a motor failure.

Unit 2 RCP 2-4 ground fault relay actuated without a valid signal. The relay energized the trip coil, which in turn, opened the breaker for RCP 2-4 and caused a low flow condition and reactor trip. During postmortem testing, TVA determined that a metal oxide varistor in the GR-5 relay, designated as device 50G on breaker locations that feed motors and transformers, failed, causing a standing trip signal.

Inspection of the 6900 volt breaker associated with Unit 2 RCP 2-4 discovered a standing trip on the breaker with the ground fault relay tripped; the relay flag was not energized. Bench testing of the GR-5 relay indicated that the relay failed and had a fixed trip signal. No evidence of damage on the relay was identified with the exception of some discoloration around a high wattage resistor.

On August 16, 2012, at 2209 DST, NRC was notified, in accordance with 10 CFR 50.72(b)(2)(iv)(B), due to reactor protection system actuation and 50.72(b)(3)(iv)(A), engineering safety feature actuation.

B. Inoperable Structures, Components, or Systems that Contributed to the Event

None

**LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET**

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
Sequoyah Nuclear Plant Unit 2	05000328	YEAR	SEQUENTIAL NUMBER	REV NO.	3 OF 7
		2012 --	001 --	00	

NARRATIVE

C. Dates and Approximate Times of Major Occurrences:

August 16, 2012 at 1926 DST RCP 2-4 Motor trip out
 August 16, 2012 at 1926 DST RCP Bus 4 Undervoltage annunciator
 August 16, 2012 at 1926 DST Unit 2 Reactor Trip and Turbine Trip
 August 17, 2012 at 1205 DST GR-5 ground fault relay removed and trip signal removed. Relay was replaced.

D. Other Systems or Secondary Functions Affected:

No other systems or secondary functions were affected by this event.

E. Method of Discovery:

The RCP trip and subsequent reactor and turbine trips annunciated on the MCR panels.

F. Operator Actions:

Operations personnel responded to the reactor trip by performing actions in accordance with Emergency Procedure E-0, "Reactor Trip or Safety Injection," and various plant procedures including, Emergency Subprocedure ES-0.1, "Reactor Trip Response." Following completion of ES-0.1 actions, operations implemented Abnormal Operating Procedure (AOP) R.04, "Reactor Coolant Pump Malfunctions."

The crew noted the RCP 2-4, 6900 volt circuit breaker opened leading to an undervoltage condition which caused the motor trip-out alarm.

G. Safety System Responses:

With the exception of, Steam Generator Number 4 Feedwater Inlet Flow Control Valve (E11S JB), which indicated dual position following the trip (validated locally to be closed), safety related equipment operated as designed. Unit 2 entered MODE 3.

LICENSEE EVENT REPORT (LER) U.S. NUCLEAR REGULATORY COMMISSION
CONTINUATION SHEET

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
Sequoyah Nuclear Plant Unit 2	05000328	YEAR	SEQUENTIAL NUMBER	REV NO.	4 OF 7
		2012 --	001 --	00	

NARRATIVE

III. CAUSE OF THE EVENT

A. Immediate Cause:

The immediate cause of the reactor trip was the trip coil for the RCP 2-4 breaker energized due to the inadvertent operation of the GR-5 relay.

B. Root Cause:

The root cause was determined to be the Preventative Maintenance (PM) instructions and implementation frequency is inadequate on GR-5 relays in critical systems. The service life of the component was reached and there is no guidance to replace the relay in the PM.

C. Contributing Factor:

The Preventative Maintenance Optimization template for solid state protective relays recommends replacement every 8 to 10 years. A weakness in the preventative maintenance program was found and is being addressed to implement a program for lifecycle management practices for relays.

IV. ANALYSIS OF THE EVENT

Prior to the event, SQN Unit 2 was operating in MODE 1 at approximately 100 percent RTP with RCS pressure and temperature near the nominal value of approximately 2233 pounds per square inch gauge (psig) and approximately 578 degrees Fahrenheit (F). Both the motor driven and the turbine driven auxiliary feedwater (AFW) [EIS BA] pumps and the atmospheric relief valves (ARV) were available.

SQN Technical Specification 3.2.5, that states, in part, "The following departure from nucleate boiling (DNB) parameters shall be maintained within the limits shown on Table 3.2-1: a. RCS average temperature, b. pressurizer pressure, and c. RCS total flow rate."

Following the reactor trip, RCS pressure rapidly decreased due to the decreasing RCS average temperature and the associated shrinking of coolant volume. The minimum RCS pressure was approximately 2010 psig, well above the pressure that would have initiated a safety injection signal (1870 psig). Pressurizer [EIS AB] pressure recovered gradually, rising to 2261 psig before dropping back to normal operating pressure.

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
Sequoyah Nuclear Plant Unit 2	05000328	YEAR	SEQUENTIAL NUMBER	REV NO.	5 OF 7
		2012 --	001 --	00	

NARRATIVE

As heat removal from the steam generators (SG) [EIS AB] decreased as a result of the increased steam pressure, the decrease in RCS temperature slowed and the rate of coolant shrinkage decreased. This allowed operation of the pressurizer heaters to restore RCS pressure to its nominal value. Because the maximum RCS pressure was only slightly above its nominal value following the reactor trip, pressurizer safety relief valves and power operated relief valves [EIS AB] did not actuate.

The DNB limit for RCS average temperature of less than or equal to 583 degrees F was not exceeded. The loss of nuclear heat generation resulted in a decrease in RCS temperature to approximately 534 degrees F.

The RCS loop 4 indicated flow decreased to approximately 12 to 18 percent flow near the time of the reactor trip due to the loss of RCP 2-4. At that time, RCS flow in the remaining three loops was approximately 113 percent flow. Forced flow was maintained by RCP's 2-1, 2-2 and 2-3 as indicated by the loop flow transmitters and also by a lack of change in loop temperatures.

The main feedwater flow rate was at nominal full power value prior to the reactor trip. When RCS average temperature dropped below 550 degrees F, main feedwater was isolated [EIS SJ]. The AFW system was initiated following the reactor trip on SG low-low level. AFW flow in all loops was reduced below 300 gpm to mitigate the decrease in RCS average temperature and also due to recovering SG levels. AFW in loop 4 was subsequently decreased to approximately 0 gpm as the SG 4 level remained higher than the other loops due to the loss of RCP 2-4. The steam dump system and ARV's operated as expected to remove decay heat.

The Updated Final Safety Analysis Report (UFSAR) event most similar to this reactor trip is the Partial Loss of Forced Reactor Coolant Flow event described in UFSAR Section 15.2.5. In the analysis of this event, a partial loss of flow involving loss of two RCPs was assumed. The resultant RCS flow rate prior to the reactor trip was greater than RCS flow rate assumed in the Partial Loss of Forced Reactor Coolant Flow analysis.

The plant responded as expected for the conditions of the trip. No Technical Specification limits were exceeded and the UFSAR analysis of the event remained bounding.

U.S. NUCLEAR REGULATORY COMMISSION
LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
Sequoyah Nuclear Plant Unit 2	05000328	YEAR	SEQUENTIAL NUMBER	REV NO.	6 OF 7
		2012 --	001 --	00	

NARRATIVE

V. ASSESSMENT OF SAFETY CONSEQUENCES

Based on the above "Analysis of The Event," following the trip all safety related equipment operated as designed, the AFW system actuated as expected and decay heat removal was provided using ARVs and the steam dump system. All DNB parameters remained within limits during this event. As a result, this event did not adversely affect the health and safety of plant personnel or the general public.

VI. CORRECTIVE ACTIONS

A. Immediate Corrective Actions:

Operations personnel responded to the reactor trip as prescribed by emergency procedures. Component testing was performed and the affected GR-5 relay was replaced on RCP 2-4 breaker.

B. Corrective Actions to Prevent Recurrence:

The following corrective actions to prevent recurrence were identified in the root cause analysis and are being tracked in accordance with the SQN Corrective Action Program.

1. The PM instructions for ABB/ITE relays in critical systems are being revised to a frequency of every five refueling cycles for relay replacement.
2. Replace the Unit 1 ABB/ITE relays classified as critical that have been in service greater than five refueling cycles, based on Operations review of critical components that are directly related to causing a plant trip or Limiting Condition for Operation (LCO) entry for 8 hours or less.
3. Replace the Unit 2 ABB/ITE relays classified as critical that have been in service greater than five refueling cycles, based on Operations review of critical components that are directly related to causing a plant trip or LCO entry for 8 hours or less.

LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
Sequoyah Nuclear Plant Unit 2	05000328	YEAR	SEQUENTIAL NUMBER	REV NO.	7 OF 7
		2012 --	001 --	00	

NARRATIVE

VII. ADDITIONAL INFORMATION

A. Failed Components:

The failed component was a GR-5 ground fault relay, made by ABB.

B. Previous LERs on Similar Events:

A review of previous reportable events for the past three years did not identify any similar events.

C. Additional Information:

The corrective action document for this report is Problem Evaluation Report (PER) 596978.

D. Safety System Functional Failure:

This event did not result in a safety system functional failure in accordance with 10 CFR 50.73(a)(2)(v).

E. Unplanned Scram with Complications:

This event did not result in an unplanned scram with complications.

VIII. COMMITMENTS

None